Remarks

Claims 1-21, claims 23-25 and 28-29 were previously cancelled without prejudice to present these claims in a separate continuation or divisional application. Claims 31 and 32 were added in the paper filed on July 10, 2006. In this paper, claims 22, 26-27 and 30-32 are cancelled and new claims 33-40 are added. Accordingly, claims 33-40 are now pending.

In the October 4, 2006 Office Action, the Examiner has withdrawn the previous rejection of claims 22-30 under 35 U.S.C. § 112, first paragraph for failing to comply with the written description requirement.

In the October 4, 2006 Office Action, claims 30-32 were rejected under 35 U.S.C. § 112 as failing to comply with the written description requirement. Claims 22, 26 and 30 were rejected under 35 U.S.C. § 102(b) as being anticipated by Hu et al., U.S. Patent No. 5,817,252, or Wiesenfield et al., U.S. Patent No. 5,935,488. Claim 27 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Hu or Wiesenfield. Claims 22, 26, 27 and 31 were rejected as being unpatentable over Reny, WO 89/09806. Claims 22, 26, 27, and 30 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Meyer, U.S. Patent No. 5,118,434, or Maes, U.S. Patent No. 5,366,651. Claims 22, 26, 27 and 30-32 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Hansen, U.S. Patent No. 4,728,452, or Wood, U.S. Patent No. 4,455,248. Claims 22, 26 and 27 were provisionally rejected under the judicially created doctrine of obviousness-type double patenting over claims 1-9, 11 and 12 of copending Application No. 10/264,041, claims 27-50 of Application No. 10/910,497 and claims 30-33 of Application No. 10/935,982.

In view of the amendments to the claims and the remarks set forth below, applicant respectfully requests reconsideration.

New claim 33 recites a method for cooling an internal combustion engine using a reduced toxicity, ethylene glycol and water based heat transfer fluid comprising ethylene glycol, propylene glycol and water. The heat transfer fluid contains propylene glycol in an amount of between 5% by weight to less than 30% by weight of the total weight of the propylene glycol and ethylene glycol in the heat transfer fluid. Support for this limitation may be found at, for example, paragraphs 0054, 0060 and 0063 which describe toxicity testing of fluids with the claimed ranges of ethylene glycol and propylene glycol.

The heat transfer fluid used in the method of claim 33 also includes water in an amount between 40% and 70% by weight of the total weight of the heat transfer fluid. Support for this limitation may be found at, for example, paragraph 0009, which states that engine heat transfer fluids typically include between 40% and 70% by weight water. New claim 33 further recites that heat transfer fluid has an oral rat LD_{50} of about 15,000 mg/kg or greater. Support for this limitation may be found at, for example, paragraph 0060 through 0063, which describe the oral toxicity of fluids having ethylene glycol and propylene glycol within the claimed range.

The use of the heat transfer fluid in the cooling system of an internal combustion engine is described throughout the specification, including at, for example, paragraphs 0002 and 0073.

New claim 34 recites the addition of at least one additive to the heat transfer fluid. The additive may be one or more of a buffer, corrosion inhibitor, defoamer, dye, scale inhibitor, surfactant or chelant. Support for this claim may be found throughout the specification, including at, for example, paragraph 0055.

New claims 35-36 recite methods for cooling a heat generating device having a liquid water based cooling system using a reduced toxicity, ethylene glycol and water

based heat transfer fluid. Support for a claim directed to a heat generating device may be found at, for example, paragraphs 0042 and 0044. The remaining limitations are the same as the limitations in claims 33-34.

New claim 37 recites a method for cooling an internal combustion engine using a reduced toxicity, ethylene glycol and water based heat transfer fluid comprising ethylene glycol, glycerol and water. The heat transfer fluid contains glycerol in an amount of between 5% by weight and 20% by weight of the total weight of the glycerol and ethylene glycol in the heat transfer fluid. Support for this limitation may be found at, for example, paragraphs 0080 to 0082 which describe toxicity testing of fluids with the claimed ranges of ethylene glycol and glycerol.

The heat transfer fluid used in the method of claim 37 also includes water in an amount between 40% and 70% by weight of the total weight of the heat transfer fluid. Support for this limitation may be found at, for example, paragraph 0009, which states that engine heat transfer fluids typically include between 40% and 70% by weight water. New claim 37 further recites that heat transfer fluid has an oral rat LD_{50} of about 15,000 mg/kg or greater. Support for this limitation may be found at, for example, paragraph 00080 through 00082, which describe the oral toxicity of fluids having ethylene glycol and glycerol within the claimed range.

The use of the heat transfer fluid in the cooling system of an internal combustion engine is described throughout the specification, including at, for example, paragraphs 0002 and 0073.

New claim 38 recites the addition of at least one additive to the heat transfer fluid. The additive may be one or more of a buffer, corrosion inhibitor, defoamer, dye, scale inhibitor, surfactant or chelant. Support for this claim may be found throughout the specification, including at, for example, paragraph 0055.

New claims 39-40 recite methods for cooling a heat generating device having a liquid water based cooling system using a reduced toxicity, ethylene glycol and water based heat transfer fluid. Support for a claim directed to a heat generating device may be found at, for example, paragraphs 0042 and 0044. The remaining limitations are the same as the limitations in claims 37-38.

As described in the specification at paragraphs 0024-0030, prior to the disclosure of the present invention, it had been known only that the addition of a less toxic substance to a more toxic substance would result in a mixture that was reduced in toxicity to the extent that the more toxic substance was diluted by the addition of the less toxic substance. As set forth in the specification at, inter alia, paragraphs 0058-0069 and 0080-0083, the present inventors unexpectedly discovered that addition of propylene glycol or glycerol to fluids containing ethylene glycol, such as for example heat transfer fluids used in automobiles, unexpectedly reduced the oral toxicity of the ethylene glycol based fluids far below the levels which would have been predicted based on the toxicity of each substance alone. Ethylene glycol is commonly used in heat transfer fluids containing water to reduce the freezing point of the fluid. Ethylene glycol is relatively inexpensive. However, ethylene glycol has an oral toxicity rating that is relatively high. As set forth in the specification, addition of as little as one to five percent by weight of propylene glycol, or as little as five percent by weight glycerol, can reduce the oral toxicity of the resulting fluid to the point where it is considered non-toxic (note that a higher LD_{50} indicates lower oral toxicity, i.e. more material must be ingested to cause a toxic effect).

As set forth in detail above, the new claims 33-40 are fully supported and described in the specification as filed. Accordingly, applicants respectfully request that the rejection under 35 U.S.C. § 112 be withdrawn.

For at least the reasons presented below for each reference cited by the Examiner, claims 33-40 are patentable under 35 U.S.C. §§ 102 and 103 over the prior art references cited by the Examiner. None of the references cited recite all of the limitations of claims 33-40. The cited references are therefore insufficient to anticipate the claims under 35 U.S.C. § 102(b). In addition, none of the references cited by the Examiner recognize the problem of oral toxicity of ethylene glycol based heat transfer fluids, much less teach or suggest a solution to this problem. Moreover, although the references cited by the Examiner recite generically that ethylene glycol and other alkylene glycols may be combined, none of the references cited by the Examiner teach or suggest combining ethylene glycol and propylene glycol in the ranges recited in the claims, which provide unexpectedly reduced oral toxicity. The cited references are therefore insufficient to support a rejection under 35 U.S.C. § 103(a). *See In re Baird*, 16 F.3d 380, 382 ("The fact that a claimed compound may be encompassed by a disclosed generic formula does not by itself render that compound obvious."). *See also In re Petering*, 301 F.2d 676, 681 (Fed. Cir. 1962)(where the prior art reference contains a broad disclosure that encompasses a vast number of compounds, the reference will not anticipate a narrow species of compounds that may be within the broadly described genus).

The Rejection Under 35 U.S.C. § 102(b) Based Upon Hu or Wiesenfeld

New claims 33-40 are not anticipated by Hu or Wiesenfeld. To anticipate a claim under Section 102(b), a single prior art reference must disclose each and every element set forth in the claim. *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631 (Fed. Cir. 1987); MPEP § 2131. Hu and Wiesenfeld, a continuation-in-part of Hu, both describe anti-icing fluids for use on airplanes. The fluids described in Hu and Wiesenfeld would not function as heat transfer fluids in internal combustion engines or devices that

generate heat, and Hu and Wiesenfeld therefore cannot meet all of the limitations of claims 33-40.

Hu and Wiesenfeld are directed to deicing compositions used on aircraft and the like. Deicing and anti-icing fluids function by chemically melting ice and preventing water from freezing by depressing the freezing point of water. A heat transfer fluid functions by mechanically absorbing heat from a hotter body and transferring the heat to a cooler body. Hu and Wiesenfeld do not describe or suggest using the fluids as heat transfer fluids and, in general, deicing and anti-icing fluids (which are sprayed onto a surface) are too viscous for use as a fluid to be circulated in an engine cooling system.

As described in the Hu patent at, for example, col. 5, lines 62-67, and in Table 4, and as described in the Wiesenfeld patent at, for example, col. 6, lines 11-17, and in Table 4, the deicing compositions of both Hu and Wiesenfeld must include a polymeric emulsifier. This component is not included in the heat transfer composition of the present invention, as set forth in the amended claims. A polymeric emulsifier such as the polycarboxylate compound described by both Hu and Wiesenfeld, with a molecular weight of between 500,000 to 3,000,000, would make the compositions of both Hu and Wiesenfeld too viscous as heat transfer fluids for cooling an internal combustion engine or any heat generating device.

Internal combustion engines, and heat generating devices in general, may be operated over a broad range of ambient temperatures, including minus 20°C. The fluid described in Hu has a viscosity of 1,000 cps at plus 20°C. Col. 9, lines 26-32. Although Hu does not state what the viscosity is at lower temperatures, Wiesenfeld provides curves of viscosity vs. temperature for fluids that are similar to Hu's. Figures 1 through 4 show the Viscosity vs. Temperature for four examples of Wiesenfeld deicing and anti-icing

compositions having a 55/45 dilutions, within the dilution range described in Hu. See also Col.10, Lines 57-64. (Note that the viscosity unit used for Figures 1-4 is the millipascal second, abbreviated as mPAS. One millipascal second is the same as one centipoise, abbreviated as cps at col. 10, lines 63-64.) Wiesenfeld shows that the viscosities of the fluids increase substantially as the temperature decreases. Although the viscosities of all four fluids in the examples are less than 100 cps at 20°C, the viscosities of all four fluids in the examples rapidly increase at temperatures between 0°C and minus 10°C, and are greater than about 18,000 cps at minus 20°C (-4°F). In contrast, none of the heat transfer fluids according to the instant claims have viscosities exceeding 100 cps at *minus* 20°C. A fluid with a viscosity as high as the fluids described in Hu and Wiesenfeld, while perhaps useful as a surface anti-icing agent, is unsuitable for use as a heat transfer fluid in internal combustion engines or other heat transfer devices because it would be virtually impossible to pump the fluid to achieve the flows required to remove heat.

The amended claims recite that the present invention is directed to a method of cooling internal combustion engines or heat generating devices using a reduced toxicity composition as a heat transfer fluid. Hu and Wiesenfeld do not even mention the use of the fluids they describe as a heat transfer fluid, and indeed they are not appropriate for such use for the reasons described above. Therefore, Hu and Wiesenfeld do not describe all of the limitations of claims 33-40, and Hu and Wiesenfeld do not teach or suggest the use of the fluids as heat transfer fluids. Accordingly claims 33-40 are not anticipated by, or obvious in view of, either Hu or Wiesenfeld for at least these reasons.

The Rejection Under 35 U.S.C. § 103(a) Based Upon Reny

New claims 33-40 are not obvious under 35 U.S.C. § 103(a) based upon Reny. Reny describes a composition which comprises "at least 90 weight percent of an alkylene

glycol or a mixture of two or more alkylene glycols". The set of alkylene glycols is very large and is comprised of ethylene glycol, diethylene glycol, triethylene glycol, tetraethylene glycol, propylene glycol, dipropylene glycol, hexylene glycol, 2 ethyl-1,3-hexanediol, 1,5-pentanediol, *and many others*. Reny does not even mention oral toxicity, much less teach or suggest a solution to that problem. As described above and in the application, the reduction in oral toxicity achieved with claimed non-aqueous heat transfer fluid was unexpected, and was much greater than the reduction that would have been predicted using the standard predictive equation used by the World Health Organization and cited in the application.

Reny states that the compound may contain ethylene glycol, propylene glycol, glycerol, or "two or more thereof in any proportion." Page 4, lines 5-6. Thus, Reny describes in a general fashion a virtually infinite number of combinations of ethylene glycol, propylene glycol and glycerol. Reny goes on to state that the alkylene glycol is preferably propylene glycol or a mixture having at least 30 weight percent propylene glycol. Page 4, lines 6-10. All of the compositions specifically described by Reny include at least 30 percent by weight propylene glycol.

Claims 33-36 recite combining ethylene glycol, propylene glycol and water to obtain a heat transfer fluid which contains between about 5 percent to less than 30 percent propylene glycol of the total weight of propylene glycol and ethylene glycol in the heat transfer fluid. Claims 37-40 recite combining ethylene glycol, glycerol and water to obtain a heat transfer fluid which contains between about 5 percent by weight and about 20 percent by weight glycerol of the total weight of ethylene glycol and glycerol in the heat transfer fluid. Reny does not teach or suggest adding propylene glycol or glycerol to an ethylene glycol based fluid in the proportions recited in the claims as amended. In fact, Reny states that the composition described therein should

preferably contain at least 30 percent by weight propylene glycol. Therefore, Reny provides no motivation to combine propylene glycol and ethylene glycol, or glycerol and ethylene glycol, in the proportions recited in the claims as amended, and suggests to the contrary that it would be undesirable to make such a combination. The only specific combination described by Reny is a fluid containing 70 parts ethylene glycol and 30 parts propylene glycol, which is not within the claims as amended. Accordingly, the claims as amended are not obvious is view of Reny. *See In re Baird*, 16 F.3d 380 383 (Fed. Cir. 1994)(finding a smaller subset of compounds unobvious in view of a reference disclosing a vast number of compounds, particularly where disclosure indicates a preference leading away from the claimed compounds); MPEP § 2144.08.

Reny also states that the heat transfer fluid should contain no more than 10 weight percent water. Page 5, line 28-30. The heat transfer fluids in the methods of claims 33-40 all contain between 40% by weight and 70% by weight water. Reny does not describe ethylene glycol based heat transfer fluids having reduced oral toxicity such as the fluids described and set forth in claims 33-40. Accordingly, the methods of claims 33-40 are not obvious in view of Reny for at least these reasons.

The Rejection Under 35 U.S.C. § 103(a) Based Upon Meyer or Maes

New claims 33-40 are not obvious under 35 U.S.C. § 103(a) in view of Meyer or Maes. Meyer describes deicing solutions comprising alkylene glycols, water, corrosion inhibitors, and one or more polymeric additives. The polymeric additives substantially increase the viscosity of the composition to make it suitable for aircraft deicing purposes. Meyer's polymeric additives are special only in that they "inhibit the precipitation of salts which cause turbidity of the compositions when admixed with water." Col. 1, lines 41-43. The prevention of the precipitation of salts is the primary objective of Meyer to address the likelihood that "the United States and Canada will soon require aircraft

deicing fluids to remain clear on contact with water." Col. 1, lines 20-24. Except for the inhibiting of the precipitates, Meyer's composition functions conventionally to prevent the formation of ice. Meyer describes the use of various polymers having a high molecular weight. These polymers cannot be used in a heat transfer fluid due to the increased viscosity and potential for fouling caused by these substances. Meyer does not describe, teach or suggest combining ethylene glycol based fluids with either propylene glycol or glycerol in any specific proportions in a heat transfer fluid, much less in the specific proportions recited in the claims as amended.

Indeed, while Meyer lists propylene glycol and ethylene glycol among numerous substances that may be used in the deicing compositions described therein, in all of the examples provided by Meyer, ethylene glycol is the only alkylene glycol used. Col. 5, line 28-col. 6, line 37. Moreover, Meyer does not even recognize the problem of toxicity of ethylene glycol based fluids, much less describe, or otherwise teach or suggest, the methods of claims 33-40. A general description that compounds may be mixed does not render obvious specific formulations that provide unexpected results. See In re Baird, 16 F.3d 380, 382 ("The fact that a claimed compound may be encompassed by a disclosed generic formula does not by itself render that compound obvious.").

As demonstrated by the test results set forth in the application at paragraphs 0058-0069 and 0080-0083, the oral toxicity of compositions containing ethylene glycol and either propylene glycol or glycerol in the specific proportions recited in the claims as amended was unexpectedly reduced to levels that render the compositions safe to use. Where, as here, the Applicant shows that a claimed range achieves unexpected results relative to the prior art, a prima facie case of obviousness is rebutted. In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); MPEP § 2144.05. There is no teaching or suggestion in Meyer to use ethylene glycol and propylene glycol in any

specific proportions, much less in the proportions recited in the amended claims, and there is no teaching or suggestion in Meyer of the results unexpectedly achieved by mixing the two in the proportions recited in the amended claims.

For at least the foregoing reasons, claims 33-40 are patentable over Meyer under 35 U.S.C. § 103(a).

Maes does not describe, teach or suggest a fluid containing any combination of ethylene glycol with either propylene glycol or glycerol, much less teach or suggest the combinations recited in the claims as amended. At col. 3, line 65 to col. 4, line 68, Maes states "The antifreeze formulations most commonly used include water and water soluble liquid alcohol freezing point depressants such as glycol and glycol ethers." In this sentence, Maes uses glycol in the singular and glycol ethers in the plural. In the sentence following, Maes provides a list of "glycol ethers which can be employed." Throughout the specification, Maes describes antifreeze formulations containing a single glycol, indicating that only a single glycol is used in the formulation. Thus, Maes plainly describes the use of a single glycol, and Maes does not teach or suggest any combination of glycols, much less the combination and proportions recited in the claims. For at least this reason, in addition to the reasons set forth in Applicants' August 16, 2004 Response to Office Action in this case, applicants' maintain that Maes does not describe, teach or suggest the combination of more than one glycol freezing point depressant for any reason, much less the addition of a second glycol to a fluid containing ethylene glycol to reduce the oral toxicity of the ethylene glycol-containing fluid as recited in the methods of the claims as amended.

Moreover, Maes does not teach or suggest combining ethylene glycol with propylene glycol for any purpose, much less for the purpose of forming a non-aqueous heat transfer fluid having reduced oral toxicity. At col. 3, lines 65-69, Maes states that

freezing point depressants suitable for the fluid he describes are "glycol" and "glycol ethers." These are very different chemicals.

To those skilled in the art, the term "glycol" in the singular means ethylene glycol, a polyhydric alcohol with direct bonding between the carbon atoms. For example, in the Handbook of Chemistry and Physics, 42nd ed., in the listing of Physical Constants of Organic Compounds, the listing for "ethylene glycol" on page 992 says merely "see glycol" with no data listed. The listing for "Glycol" on page 1016 provides data only for ethylene glycol. Glycol ethers, on the other hand, consist of hydrocarbon groups bonded through an oxygen atom. At col. 3, line 69 through col. 4, line 8, Maes states, "The glycol **ethers** which can be deployed as major components in the present composition include glycols such as ethylene glycol, diethylene glycol, propylene glycol, and dipropylene glycol, and glycol monoethers such as the methyl, ethyl, propyl, and butyl ethers of ethylene glycol, diethylene glycol, propylene glycol, and dipropylene glycol." The sole mention of propylene glycol by Maes only appears in his listing of glycol ethers, i.e. as propylene glycol ether. Ethylene glycol, the preferred freezing point depressant in Maes, is listed at col. 3, line 67 as "glycol."

In addition, Maes does not describe, teach or suggest a method to reduce the oral toxicity of an ethylene glycol containing fluid by addition of a second glycol, such as propylene glycol or glycerol, as recited in the amended claims. Even if Maes described fluids containing combinations of ethylene glycol with either propylene glycol or glycerol, which Maes does not do as discussed above, Maes clearly does not teach or suggest combining an ethylene glycol based heat transfer fluid in any specific proportions with propylene glycol or glycerol. A general description that compounds may be mixed does not render obvious specific formulations that provide unexpected results. See In re Baird, 16 F.3d 380, 382 ("The fact that a claimed compound may be encompassed by a

disclosed generic formula does not by itself render that compound obvious."); MPEP 2144.08.

As set forth in the specification, the present inventors discovered that adding a second polyhydric alcohol, such as propylene glycol or glycerol, in the specific proportions recited in the claims as amended to an ethylene glycol based heat transfer fluid unexpectedly reduced the toxicity of the resulting fluid below the level that would have been predicted based on the properties of the individual fluids. Where, as here, a claimed range achieves unexpected results, the claimed range is patentable over the prior art. In re Woodruff, 919 F.2d 1575 (Fed. Cir. 1990); MPEP § 2144.05. Accordingly, even under the Examiner's reading of Maes, which applicants maintain is incorrect, claims 22, 26-27, and 30-32 are nevertheless patentable under 35 U.S.C. § 103 for at least this reason.

At page 10 of the Office Action, the Examiner correctly states that Maes does not teach with sufficient specificity a method for reducing the toxicity of an ethylene glycol based fluid by the addition of a polyhydric alcohol such as propylene glycol or glycerol. The Examiner incorrectly states, however, that it would have been obvious to one skilled in the art to reduce the oral toxicity of an ethylene glycol based fluid because Maes teaches or suggests reducing the oral toxicity by addition of a diol such as propylene glycol. Maes does not recognize or discuss the problem of reducing the oral toxicity of ethylene glycol based fluids, much less describe, teach or suggest a method to reduce the toxicity of a non-aqueous ethylene glycol based fluid as recited in the new and amended claims. Moreover, Maes does not describe, teach or suggest, combining ethylene glycol containing fluids with a polyhydric alcohol such as propylene glycol or glycerol in any specific proportions, much less the specific proportions recited in the amended claims.

For at least the foregoing reasons, claims 33-40 are patentable over Maes under 35 U.S.C. § 103(a).

The Rejection Under 35 U.S.C. § 103(a) Based Upon Hansen or Wood

New claims 33-40 are patentable over Hansen under 35 U.S.C. § 103(a). Hansen describes coolant compositions for use in aqueous coolant systems. Col. 1, lines 7-10. The compositions include water soluble corrosion inhibitors to reduce corrosion of metal surfaces in the cooling system using aqueous coolants. Col. 2, lines 24-57. Hansen states that the corrosion inhibitor composition may be used in water alone, "or water in admixture with freezing point depressing amounts of at least one alcohol, at least one glycol or a mixture of at least one alcohol and at least one glycol" in a closed aqueous cooling system. Col. 2, lines 40-44. Hansen states that "mixtures of ethylene glycol and diethylene glycol are particularly preferred." Col. 3, lines 40-41. Hansen does not describe, teach or suggest adding a second glycol, such as propylene glycol or glycerol, to an ethylene glycol containing fluid to reduce the oral toxicity of the fluid as recited in claims as amended. Accordingly, the claims as amended are not obvious is view of Hansen. *See In re Baird*, 16 F.3d 380 383 (Fed. Cir. 1994)(finding a smaller subset of compounds unobvious in view of a reference disclosing a vast number of compounds, particularly where disclosure indicates a preference leading away from the claimed compounds).

Hansen does not describe, teach or suggest combination of an ethylene glycol containing fluid with a second glycol, such as propylene glycol, in any proportions, much less in the proportions set forth in claims 33-40. The general description that compounds may be mixed does not render obvious specific formulations that provide unexpected results. See In re Baird, 16 F.3d 380, 382 ("The fact that a claimed compound may be

encompassed by a disclosed generic formula does not by itself render that compound obvious."); MPEP 2144.08.

Moreover, as demonstrated by the test results set forth in the application at paragraphs 0058-0069 and 0080-0083, the addition of propylene glycol or glycerol to fluids containing ethylene glycol in the proportions recited in the claims as amended unexpectedly reduced the oral toxicity of the ethylene glycol containing fluid to levels that render the fluid safe. Where, as here, the Applicant shows that a claimed range achieves unexpected results relative to the prior art, a prima facie case of obviousness is rebutted. In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); MPEP § 2144.05. There is no teaching or suggestion in Hansen to combine ethylene glycol with either propylene glycol or glycerol in any amount, much less in the proportions recited in claims 33-40.

At pages 9-10 of the Office Action, the Examiner correctly states that Hansen does not teach with sufficient specificity a method for reducing the toxicity of an ethylene glycol based fluid by the addition of a polyhydric alcohol such as propylene glycol or glycerol. The Examiner incorrectly states, however, that it would have been obvious to one skilled in the art to reduce the oral toxicity of an ethylene glycol based fluid because Hansen teaches or suggests reducing the oral toxicity by addition of a diol such as propylene glycol. Hansen does not recognize or discuss the problem of reducing the oral toxicity of ethylene glycol based fluids, much less describe, teach or suggest a method to reduce the toxicity of a non-aqueous ethylene glycol based fluid as recited in the new and amended claims. Moreover, Hansen does not describe, teach or suggest, combining ethylene glycol containing fluids with a polyhydric alcohol such as propylene glycol or glycerol in any specific proportions, much less the specific proportions recited in claims 33-40.

For at least the foregoing reasons, claims 33-40 are patentable over Hansen under 35 U.S.C. § 103(a).

New claims 31-32 are also patentable over Wood under 35 U.S.C. § 103(a). Wood describes an antifreeze coolant composition for use in aqueous coolant systems and heat transfer services. Col. 3, lines 13-26. The compositions include water soluble corrosion inhibitors to reduce corrosion of metal surfaces in the cooling system using aqueous coolants. Wood states that the corrosion inhibitor composition is based upon one or more glycols. Col. 2, lines 56-67. Wood lists several glycols that may be used in the formulation, but Wood does not describe any specific mixtures of glycols. Wood states that ethylene glycol is most preferred, col. 3, lines 1-2, and all of the examples provided in Wood use only ethylene glycol. Col. 5, line 9 to col. 6, line 54.

Wood does not describe, teach or suggest combination of an ethylene glycol containing fluid with a second glycol, such as propylene glycol or glycerol, in any proportions, much less in the proportions recited in the claims as amended. The general description that compounds may be mixed does not render obvious specific formulations that provide unexpected results. See In re Baird, 16 F.3d 380, 382 ("The fact that a claimed compound may be encompassed by a disclosed generic formula does not by itself render that compound obvious."); MPEP 2144.08.

Moreover, as demonstrated by the test results set forth in the application at paragraphs 0058-0068 and 0080-0083, the addition of propylene glycol or glycerol to fluids containing ethylene glycol in the proportions recited in the claims as amended, unexpectedly reduced the oral toxicity of the ethylene glycol containing fluid to levels that render the fluid safe. Where, as here, the Applicant shows that a claimed range achieves unexpected results relative to the prior art, a prima facie case of obviousness is rebutted. In re Woodruff, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); MPEP §

2144.05. There is no teaching or suggestion in Wood to combine ethylene glycol and a second glycol, such as propylene glycol or glycerol, in any proportions, much less in the specific proportions recited in claims 22, 26-27 and 30-32.

At pages 11-12 of the Office Action, the Examiner correctly states that Wood does not teach with sufficient specificity a method for reducing the toxicity of an ethylene glycol based fluid by the addition of a polyhydric alcohol such as propylene glycol or glycerol. The Examiner incorrectly states, however, that it would have been obvious to one skilled in the art to reduce the oral toxicity of an ethylene glycol based fluid because Wood teaches or suggests reducing the oral toxicity by addition of a diol such as propylene glycol. Wood does not recognize or discuss the problem of reducing the oral toxicity of ethylene glycol based fluids, much less describe, teach or suggest a method to reduce the toxicity of a non-aqueous ethylene glycol based fluid as recited in the new and amended claims. Moreover, Wood does not describe, teach or suggest, combining ethylene glycol containing fluids with a polyhydric alcohol such as propylene glycol or glycerol in any specific proportions, much less the specific proportions recited in the claims as amended.

For at least the foregoing reasons, claims 33-40 are patentable over Wood under 35 U.S.C. § 103(a).

The Claimed Heat Transfer Fluids Yielded Unexpected Results in Toxicity Testing

At page 15 of the Office Action, the examiner states:

> Additionally, Applicant has reiterated that on pages 17-21 [paragraphs 0058-0072] of the specification, unexpected and superior results of the claimed invention are shown with respect to toxicity. The Examiner asserts, as stated previously, that this data is insufficient to overcome the prior art rejections applied above. It is unclear to the examiner exactly what unexpected results are being shown; it seems that one of ordinary skill in the art would reasonably expect that the toxicity of ethylene glycol would be reduced when combined with propylene glycol since propylene glycol is much less toxic than ethylene glycol.

Thus, the data does not appear to show any unexpected and superior results but just merely shows what would be expected."

The examiner is incorrect. The applicant has provided more than sufficient evidence in the specification to demonstrate that the compositions yield unexpected results regarding oral toxicity. Figure 2 is a graph of the predicted LD_{50} values for mixtures of ethylene glycol and propylene glycol, and shows what one of ordinary skill in the art would have expected for the toxicity of combinations of ethylene glycol and propylene glycol prior to the disclosure in the specification of the present application. For example, from Figure 2, a 95% ethylene glycol and 5% propylene glycol mixture has an expected LD_{50} of about 5,000 mg/kg. Actual testing showed the LD_{50} of that mixture to be about 15,000 mg/kg. See paragraph 0068. The very low toxicity (very high LD_{50} value) result was indeed very surprising and unexpected. One of ordinary skill in the art would have reasonably expected that you would have needed 10% ethylene glycol and 90% propylene glycol to reach an LD_{50} of about 15,000 mg/kg. See Figure 2.

Figure 3 is a graph of the predicted LD_{50} values for mixtures of ethylene glycol and glycerol, and shows what one of ordinary skill in the art would have expected for the toxicity of combinations of ethylene glycol and glycerol prior to the disclosure in the specification of the present application. For example, a 95% ethylene glycol and 5% glycerol mixture has an expected LD_{50} of about 5,000 mg/kg as predicted in Figure 3. Actual testing showed the LD_{50} of that mixture to be about 15,000 mg/kg. See paragraph 0082. The very low toxicity (very high LD_{50} value) result was indeed very surprising. One of ordinary skill in the art would have reasonably expected that there was no possible combination of EG and glycerol that could have produced an LD_{50} of about 15,000 mg/kg. See Figure 3.

There are numerous examples in the specification demonstrating that the claims heat transfer fluids have a substantially lower oral toxicity than one skilled in the art would have predicted. Accordingly, the examiner is incorrect in stating that the specification does not support applicant's claim of unexpected results.

The Double Patenting Rejection

The Examiner has issued a provisional double patenting rejection citing four copending patent applications. Copending applications 09/910,497 and 09/935,982 describe non-aqueous heat transfer fluids having reduced toxicity. The non-aqueous heat transfer fluids described in these applications are (1) formulated to contain less than one half percent water, (2) contain water only as an impurity, and (3) are used without the addition of water. The examiner nevertheless asserts that " the specifications of these applications allows (sic) for the presence of some water which would fall within the normal meaning of 'aqueous'", thereby causing a conflict with the instant application. The examiner's definition of aqueous is inappropriate and overly broad as it includes coolants that are clearly defined as non-aqueous according to the specifications of the copending matters.

Furthermore, an ordinary person skilled in the art understood, years before the priority dates of the copending applications, that polyhydric alcohols such as EG, PG, and glycerol have boiling points that are much higher than the boiling point of water. It was also understood that combining a polyhydric alcohol with water produced a solution having a boiling point very different from the boiling point of the polyhydric alcohol but only slightly different from the boiling point of water. For example, mixing ethylene glycol and water 50%/50% by weight makes a solution that boils at 107°C at atmospheric pressure, a boiling point that is 90°C less than the boiling point of ethylene glycol but just 7°C greater than the boiling point of water.

In fact, a primary virtue of a cooling system using a non-aqueous polyhydric-based heat transfer fluid is that the boiling point of the heat transfer fluid is much higher than water. It is relatively easy to condense the vapor from a polyhydric alcohol as compared to water vapor because the vapor from a polyhydric alcohol condenses at a much higher temperature.

In an aqueous cooling system, water is an important constituent of the heat transfer fluid and therefore any water vapor must be condensed to liquid water and retained in the system. Aqueous cooling systems are pressurized to increase the temperature at which water vapor can condense. By contrast, in a non-aqueous cooling system using polyhydric alcohols, any water present is an impurity and not a functional element of the cooling system. The polyhydric alcohol fraction of any vapor condenses immediately in the liquid heat transfer fluid, which is colder than the boiling point of the polyhydric alcohol. If there is contamination of the polyhydric alcohol by a small amount of water, any vapor will also contain a water vapor fraction. The water vapor fraction cannot condense in the liquid heat transfer fluid because the liquid heat transfer fluid is normally hotter than the boiling point of water. Water vapor that may exist is treated as an impurity and vented from the cooling system.

In an aqueous cooling system water dominates the boiling point of the heat transfer fluid. In a non-aqueous cooling system water does not dominate the boiling point of the heat transfer fluid. There are other important differences between how aqueous and non-aqueous heat transfer fluid work but the boiling point issue alone is sufficient to differentiate aqueous and non-aqueous heat transfer fluid.

As recited in claims 33-40, the heat transfer fluids used in the methods of the present invention contain between 40% and 70% water. The heat transfer fluids of the instant claims are thereby aqueous and are distinctly different from the non-aqueous heat

transfer fluids of the copending applications. It would not be obvious to modify a non-aqueous heat transfer fluid intended for use with no added water by adding 40% to 70% water. Similarly, it would not be obvious to modify a heat transfer fluid containing 40% to 70% water used in a water based cooling system by removing all of the water. Therefore, applicant maintains that the double patenting rejection based upon these two pending non-aqueous applications is improper and should be withdrawn.

Regarding the double patenting rejection based upon application serial no. 10/264,041, pursuant to MPEP § 804, if this is the sole remaining rejection prior to issuance of any of the copending applications as patents, this rejection should be withdrawn in this case. While Applicants do not admit that the claims of the present invention are obvious in view of any one of those copending applications, in the event that one or more of the copending applications issues as a patent prior to this application, Applicants will file a terminal disclaimer to obviate the double patenting rejection.

In view of the foregoing remarks, this application should now be in condition for allowance. A notice to this effect is respectfully requested. If the Examiner believes after considering these remarks, that the application is not in condition for allowance, the Examiner is requested to call the Applicant's attorney at the telephone number listed below.

Because the reasons above are sufficient to traverse the rejection, Applicants have not explored, nor do they now present, other possible reasons for traversing such rejections. Nonetheless, Applicants expressly reserve the right to do so, if appropriate, in response to any future Office Action.

A petition for a two month extension of time and the associated fee is filed concurrently herewith. Because March 4, 2007 fell upon a non-business day, this Response to Office Action is timely filed on the following business day. If any additional

fee is required, or if necessary to cover any deficiency in fees previously paid, authorization is hereby given to charge our Deposit Account No. 50-3569.

Respectfully submitted,

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